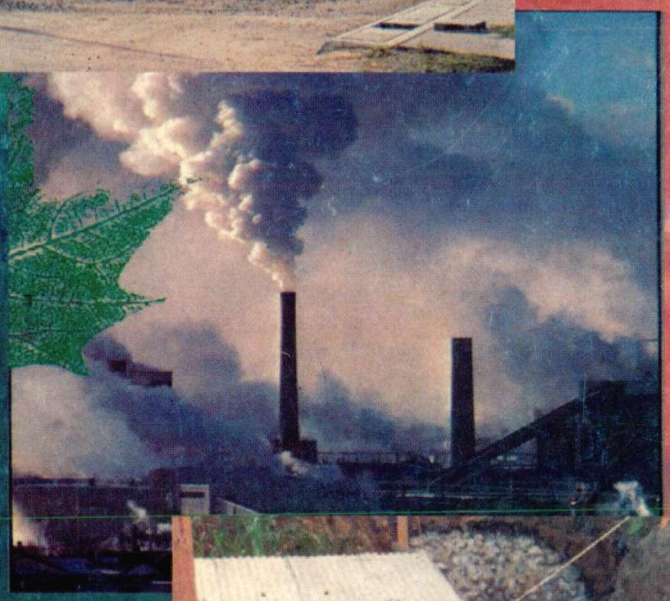
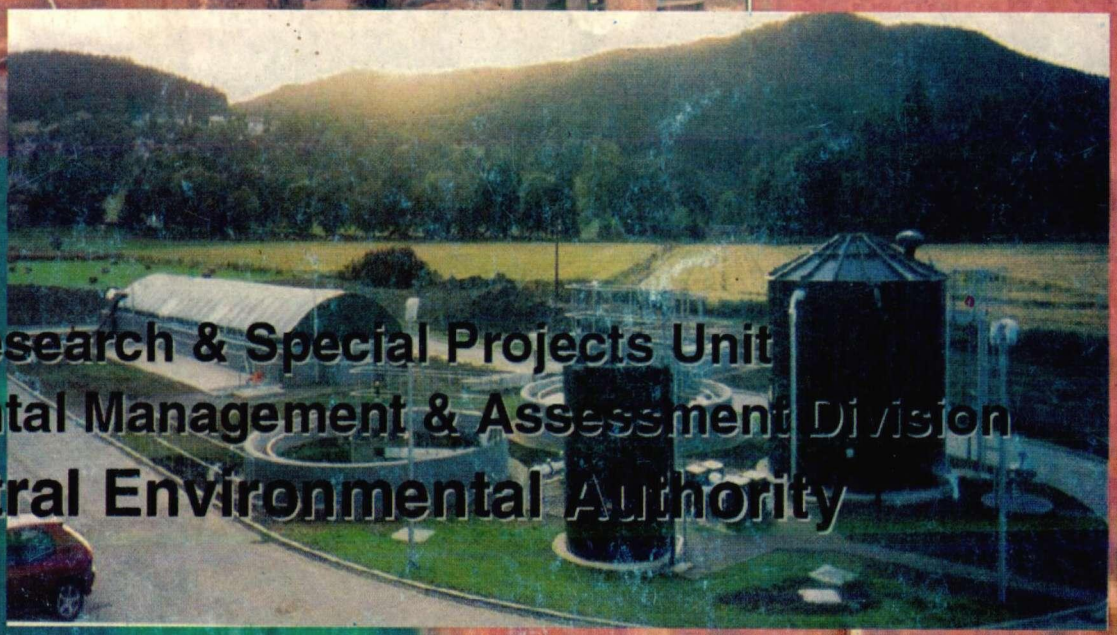
Prioritization of Environmental Research Needs in Sri Lanka



Proceedings of a Workshop held in Trans Asia Hotel, Colombo 02, Sri Lanka 20th December 2000



Research & Special Projects Unit
Environmental Management & Assessment Division
Central Environmental Authority

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Proceedings of a Workshop
held at Trans Asia Hotel,
Colombo 02,
Sri Lanka,
20th December 2000

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Central Environmental Authority

June 2001

COLOPHON

Expert Advice

Prof. Sarath Kotagama (Professor of Environmental Science, University of Colombo)
Lionel Jayasinghe (Director General, Central Environmental Authority)

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CONTENTS

FOREWORD

Almost all complex processes in our environment are directly or indirectly subject to threats and pressures from human interference. Knowledge, resulting from environmental research, has vast potential in finding solutions to most human induced environmental issues and associated problems such as soil degradation, depletion of forest cover, over-exploitation of non-renewable natural resources and all forms of waste management, to name a few.

Any country which seeks to achieve sustainable development, irrespective of whether it is a developing country or a developed country, requires close interaction and collaboration between policy makers, research scientists and the general public in order to tread the path of sustainable development.

The application of new discoveries / findings made in the recent past through scientific research has had a significant impact on the environment, and thus on national, economic and social development.

With the establishment of a new Research and Special Projects Unit in the Environmental Management and Assessment Division of the Central Environmental Authority, it was considered necessary as well as prudent to concentrate on environmental research, and identify the gaps and inadequacies in environmental research activities carried out in the country, and to formulate a listing of such research in order that it could be taken up at a national forum. This was intended to provide an opportunity for the experts / scientists in the environmental field to further deliberate, refine and prioritize the Environmental Research Agenda.

We expect to use the prioritized Environmental Research Agenda (the expected outcome of the present Workshop) as a guiding document, and it is our fervent hope that researchers and scientists in the environmental field will embark upon new research and thereby contribute towards filling existing gaps in this field.

We also hope to establish expert committees (at least four, covering four major subject areas) to review the agenda annually, and move towards the development of a National Environmental Research Policy.

Ramani Ellepola
Deputy Director General,
Environmental Management & Assessment Division,
Central Environmental Authority

EXECUTIVE SUMMARY:

A phenomenal growth in scientific and technological research was witnessed especially in industrialized countries, particularly during the latter half of the 20th century. In the developing countries of the Third World however, a comparatively low priority was assigned to research and development largely due to economic reasons. The levels of expenditure allocated to research and development have continued to remain at relatively low levels.

Sri Lanka is endowed with a pool of highly qualified scientists, researchers, technologists and technocrats who constitute an invaluable indigenous manpower resource base. However, the full potential of the knowledge of these scientists has so far not been harnessed for the socio-economic betterment of the country.

In this context, scientific research becomes an essential factor for the country if it is to move up the ladder of development. A concerted effort to identify gaps, imbalances, and repetitions if any, in the Environmental Research Agenda should be accorded high priority since this would, in turn, facilitate sustainable development.

With this need in mind, a "One day National Programme on Prioritization of Environmental Research Needs in Sri Lanka" was held in Colombo, on 20th December 2000, under the auspices of the Ministry of Forestry and Environment, with financial support from EA1P. The participants at this Workshop were invited by virtue of their particular expertise in the relevant fields, based upon the information furnished to the CEA by way of a questionnaire distributed among them. The participants were a group of about 70, representing various disciplines in the environmental field. The concept of a workshop originated in the course of an informal discussion held in July 2000 in Colombo, after the formation of the new Research and Special Projects Unit of the CEA, at which the officials of the Ministry of Forestry and Environment and Prof. S W Kotagama of the Department of Environmental Sciences of the University of Colombo participated.

The objectives of this programme were to assess the present state of environmental research in Sri Lanka, assess environmental research needs, to identify any existing gaps and prepare a future Environmental Research Agenda for Sri Lanka based on national priorities.

The Workshop consisted of two sessions, namely the Inaugural Session and Technical Session. In the Inaugural Session, the introductory remarks and welcome address were delivered by Mr. Lionel Jayasinghe, Director General, CEA, while Mr. N Pathmanathan, Secretary, Ministry of Forestry & Environment made the keynote address. A message from the Hon. Minister of Forestry and Environment was read, in his absence, by a Ministry official. Ms. Ramani Ellepola, Deputy Director General, EM&A Division, CEA gave the vote of thanks.

The Technical Sessions comprised three parts. The first part titled 'State of Environmental Research and its Institutional Mechanism in Sri Lanka' was chaired by Dr. Sumith Pilapitiya, Resident Task Manager of the World Bank. Prof. Sarath Kotagama made a presentation titled "Overview of Environmental Research in Sri Lanka, present status, trends, national policies, strategies and institutional mechanisms" which included a review, an evaluation of the present status and trends, and national policies and strategies and institutional mechanisms.

Part 2 focused primarily on the identification and the prioritization of the research areas. The participants were divided into 4 groups based on their expertise, professional skills or according to their preferences.

These four groups discussed the existing key environmental issues which included an evaluation of the research carried out, an assessment of the adequacy of the findings and identification of gaps and priority areas in the fields of land, atmosphere and water resources. Group I focused on land resources while Groups II and III focused on water and atmospheric resources. Areas such as bio-diversity, fauna and flora, socio-economics and solid waste management were the primary

focus of Group IV. Each participant was given a set of guidelines in order to facilitate discussions. Part III included group presentations made by individual groups representing the priority research areas identified under each category as well as specific recommendations.

The Workshop also addressed several issues such as the need for the development of a comprehensive environmental research database, and a mechanism to co-ordinate environmental research and other research-based tasks and activities. The Workshop resulted in a series of recommendations in addition to the compilation of a prioritized research agenda. The other recommendations / suggestions and proposals agreed upon were listed under 'Resolutions & Recommendations'.

Workshop arrangements

Prior to the Workshop, participants were provided with a background document on the Workshop, setting out the content of the programme. The other documents provided were a set of guidelines for group activities, a provisional research agenda prepared by the CEA , a list of research titles obtained from the database maintained by the National Science Foundation and a list of ongoing and completed research projects carried out under each category extracted from the database developed and maintained by the Research & Special Projects Unit of the CEA.

Acknowledgments

The Central Environmental Authority wishes to express its sincere thanks to Hon. Mahinda Wijesekara, Minister of Forestry & Environment, for the leadership and guidance given, and to Mr. N Pathmanathan, Secretary, Ministry of Forestry & Environment, for his participation and valuable contribution.

We also wish to record our gratitude to Prof. Sarath Kotagama of the Department of Environmental Sciences, University of Colombo who assisted us in numerous ways by tendering invaluable advice and providing guidance on scientific and technical matters.

The organizers also wish to thank Mr. Thilak Hewawasam, Chairman, CEA, Mr. Lionel Jayasinghe, Director General, CEA, Mrs Ramani Ellepola, Deputy Director General (Environmental Management & Assessment), CEA ,for the advice, guidance and support extended from the conceptual stage right up to the end of the Workshop.

Our sincere thanks are also due to Mr. Gamini Gamage, Director (Bio-diversity & Natural Resources Management) Ministry of Forestry & Environment and to Dr. H M Kodisinghe, Deputy Director (Natural Resources Management) Ministry of Forestry & Environment for their fullest co-operation, support and also for making arrangements to mobilize funds through EA1P.

Special thanks are due to Mr. Bathiya Sumitraarachchi, Co-ordinator, EA1P, Ministry of Forestry & Environment for providing funds from the EA1P, without which this Workshop would not have been possible. We are also thankful to all the researchers, Government officials, university academics and other individuals for their co-operation in sending the completed questionnaires which formed the base for preparation of the database.

The assistance given by Dr. Sumith Pilapitiya, Resident Task Manager, World Bank by chairing the Technical Session, Dr. Ajith de Alwis, Senior Lecturer, University of Moratuwa and Dr. Channa Bambaradeniya, Head-Biodiversity Division, IUCN who provided the situation analysis on Air Quality & Bio-diversity respectively is also gratefully acknowledged.

Finally we wish to thank all participants, group leaders and rapporteurs for their dedication and active participation and support, without which the objectives of the Workshop could not have been achieved.

MESSAGE OF THE HON. MINISTER OF FORESTRY AND ENVIRONMENT DELIVERED AT THE OPENING SESSION

The future is as full of promise as it is with uncertainty and danger. The society of the new millennium will be based on knowledge. The world will then be divided between those with knowledge and those without it. Sri Lanka also must learn and be part of the knowledge-based world if we are to benefit from it. There is no other field of knowledge more complex than that of the environment we live in. Not only is it complex and dynamic in its own right as the 'environment of Sri Lanka', but it is also caught up in the grip of global influences over which we have very little control.

Therefore, I congratulate the Central Environmental Authority for convening this meeting. I am aware that Her Excellency the President has also encouraged the CEA to include research as a priority area of activity. Scientific research is the only method by which we can understand nature and our environment. I have done much research in preparation for legal battle. I research through legal precedent to build arguments. But I know that knowledge based on scientific research is different. It is different because it can be tested and it is reliable. Therefore it is knowledge based on scientific research that provides knowledge both for correct policy as well as for implementation of policy.

At this point I have to make a distinction. The distinction is between information based on scientific research, and communication of that information. In Sri Lanka we have a large community of scientists trained in both natural and social sciences. Because of the efforts of many of these scientists, there exists a vast amount of research information. It exists as published information, unpublished reports and also in in locked drawers. Information by itself is irrelevant. For me, information is important when it is communicated. When information is communicated, it changes behaviour and attitudes. At this point information becomes knowledge.

I have participated in many discussions at which I have been told that 'there is no information'. I know the problem is different. As I said before, much information already exists, but it is 'not available', or to use a more relevant term ' it is not accessible'. There are many reasons for this problem. I urge you to address this problem with great seriousness.

There is also an even more serious problem. The universities may do research in their particular area of interest. This we cannot prevent. My concern is for research done with 'public money'. There is much information based on research done by our national agencies which is 'hidden' or remains in the grasp of individuals. This information belongs in the 'public domain'. It must be communicated. It must enter the 'institutional memory' of the national agencies and become public knowledge. I, as the Minister want to know and become knowledgeable so that I can guide policy.

I urge all the distinguished participants at this highly significant meeting to, among others, address the issue of the relationship between scientific information, communication and knowledge. I conclude by saying, help me with your findings to guide Sri Lanka to deal with her environmental challenges with knowledge.

Hon. Mahinda Wijesekara
Minister of Forestry & Environment,

ADDRESS BY THE SECRETARY TO THE MINISTRY OF FORESTRY & ENVIRONMENT

It gives me pleasure to address the audience on the occasion of the inauguration of the ' One day National Programme on Prioritization of Environmental Research Needs in Sri Lanka', jointly organized by the Central Environmental Authority & the Ministry of Forestry & Environment with financial support from the Environmental Action 1 Project. I see this as a great event, as this is, to my knowledge, the first ever attempt to bring scientists of various disciplines under one umbrella to focus on current environmental issues confronted by the country and to work towards achieving tangible solutions by conducting research activities for the ultimate benefit of the nation.

We all are very much aware that the world population growth affects the environment by increasing the indiscriminate exploitation of natural resources. The global population doubled between 1950 and 1987, and is expected to reach 6.25 billion by the end of 2000. The increasing population, combined with the tremendous pressure exerted on the natural resource base to exploit the limited resources, has resulted in creating serious environmental damages, some of which are irreversible in nature. It cannot be denied that the process of development provides better living conditions for the human being, but it has greater negative impacts on man's surroundings. This results in both industrialized and developing countries facing common problems of global warming, ozone depletion, toxic waste disposal etc.

It is well known that both industrialized and developing countries have been facing the challenges of finding judicious answers to the environmental issues they confront, though the nature, magnitude and intensity of the problems, of course, may vary from country to country. The fundamental environmental issues faced by one country may invariably differ from the other, and within the country itself, the kind of problems confronted today may not be the same problems found in the future. On the other hand, mere transposition of development models in developed countries may not be totally relevant to developing countries, depending on the development objectives, of which the latter might be more concerned about equity and social justice to help overcome wide income disparities.

It is apparent that researches from developed and developing countries tend to approach environmental issues from opposite ends, the former instinctively look for conservation oriented solutions, whereas the latter look for ways of reconciling growth and exploitation with sustainable resource use. Initially, and even today to a certain extent, research activities were conducted in an isolated and scattered manner, and reflected the interests of the one who carried out research, rather than address the requirements of society. By implication, much environment research emanates from the interest of the researchers themselves. Therefore, we believe that environmental researchers should probably be re-oriented in order to reflect the needs of the end users society.

Therefore, our endeavor today, is to attempt to pool the actual environmental research requirements of our country and to harness renowned indigenous scientific manpower resources in order to come forward with a reasonable analytical approach in identifying our research requirements and prioritizing them in the form of a research agenda so that the researchers / scientists / technologists etc. could choose these areas for their research work with the ultimate goal of sustainable development of the country.

Lastly, I take this opportunity to offer my sincere thanks to officials of the CEA and the Ministry of Forestry and Environment for organizing this National Programme, and to EA1P for extending financial support to host this programme.

N Pathmanathan
Secretary,
Ministry of Forestry & Environment

MESSAGE OF THE CHAIRMAN, CENTRAL ENVIRONMENTAL AUTHORITY

The Central Environmental Authority (CEA) was set up under the provisions of the National Environmental Act (NEA) of No. 47 of 1980. The mandate of the CEA was to protect and manage the environment. Policy making, co-ordination and advisory matters were primary functions of the CEA. With the amendment made to the NEA in 1988, the CEA was given the responsibility of enhancing the environment through regulation and control of the quality of the environment. It is also responsible for the prevention, abatement and control of pollution. Therefore the functions were basically changed to a technical, regulatory and enforcement role.

With the formation of a separate Ministry to take charge of the subject of environment, the Environment Division (established under the Ministry) took over the task of policy formation, and the CEA was designated to function as the regulatory arm of the Ministry.

The CEA has to now face the new external challenges that are complex, divergent, multi-disciplinary and more significant than they were before. This has created the need for the organizational changes in the CEA.

With the recommendation of the 'Strategic Human Resource Management Plan for the CEA, prepared under auspices of the Environmental Action 1 Project, the Environmental Management & Assessment Division (EM&A) which was under the purview of a Deputy Director General was divided into three Units, the Research and Special Projects Unit (R&SP) being one of them.

The objectives set out by the R&SP Unit includes facilitation of environmental research for the protection of the environment through development, co-ordination &implementation of a National environmental research agenda and dissemination of researched information among agencies, stakeholders and the general public.

Sri Lanka has predicted a population of 25 million by 2040, which will create enormous environmental stress due to the demand for food, housing, energy and almost all the natural resources for various activities. As a result, forest cover, water resources, air and other living or non living resources can be seriously threatened. Also, there will be a cumulative negative effect owing to the disposal of waste (both solid and liquid), contamination of air and water and land degradation.

Therefore, it is essential to have a process to analyze, assess and review the existing situation and to develop strategies and mechanisms to manage the environment for sustainability. For this process to develop, it is vital to have reliable information. The gathering of information can be arranged through various processes. One such process is to organize a workshop for professionals in order that they may get together to discuss various environmental issues, identify priority areas of research and find ways of optimizing dissemination of information.

This Workshop is to prioritize and prepare an environmental research agenda which is vital for the highlighting of data gaps in natural resources and environmental information.

Thilak Hewawasam
Chairman,
Central Environmental Authority.

ADDRESS BY THE DIRECTOR GENERAL, CENTRAL ENVIRONMENTAL AUTHORITY

Mr. N Pathmanathan, Secretary, Ministry of Forestry & Environment, Dr. Sumith Pilapitiya, Task Manager, World Bank, Mrs. Manel Jayamanne, Asst. Resident Representative, UNDP, Senior Officers of the Ministry of Forestry & Environment and Central Environmental Authority, distinguished invitees and participants

Today is a historic day for the environmental sector because, for the first time, we are all poised to focus our attention on environmental research. It is my pleasant task this morning to welcome you all to this inaugural session of the " One day National Programme on Prioritization of Environmental Research Needs in Sri Lanka" organized by the Central Environmental Authority in collaboration with the Ministry of Forestry & Environment. A special word of welcome to Mr. N Pathmanathan, Secretary, Ministry of Forestry & Environment, who kindly accepted our invitation to deliver the keynote address.

The CEA is mandated under the National Environmental Act, I quote "to conduct, promote and co-ordinate research in relation to any aspect of environmental degradation or the prevention thereof, and to develop criteria for the protection and improvement of the environment". Her Excellency the President has directed that we fulfill this mandate, and my Honorable Minister has reiterated this requirement on many occasions. With this background, the CEA took up the challenge and went ahead and established the Research & Special Projects Unit under the Environment Management & Assessment Division. Today's meeting is one of the first activities that it is handling.

Research results in new knowledge. New knowledge is necessary for progress. Research is therefore needed for national development whether it be economic and social progress or improvement of the quality of life. Of course, adequate resources and funding have to be provided for research. The latter half of the 20th century has witnessed a phenomenal growth of scientific and technological research and associated development in industrialized countries. In the developing countries of the Third World research & development expenditure has been given low priority for economic reasons, and science and technology capabilities have not developed or impacted to the same extent. Sri Lanka is no exception. However it is a well-known fact that no country can progress without research & development. Environmental research is essential if we are to achieve sustainable development.

The objectives of today's programme can be summarized as:-

Firstly; to assess the state of environmental research in Sri Lanka, whether it be basic research, applied research or experimental development, and to identify the existing institutional mechanisms for research., **Secondly;** to assess environmental research needs and to identify gaps and, **Finally;** to prepare the future Environmental Research Agenda for Sri Lanka with national priorities.

To accomplish these tasks we have assembled a distinguished array of personalities drawn from universities, research institutions, Government institutions NGOs and media as well as individuals; and to facilitate this exercise we have invited an eminent panel of resource persons. I am confident that all of us can interact and will be able to achieve the objectives of today's meeting. I shall conclude by wishing you all a very successful day of work.

I now have the pleasure of inviting Mr. N Pathmanathan, Secretary, Ministry of Forestry & Environment to deliver the keynote address.

Lionel Jayasinghe
Director General,
Central Environmental Authority

PART I: PRINCIPAL CONCLUSIONS

Introduction

It is widely known that the environmental research presently being carried out in Sri Lanka does not address the broader needs of the country. It has, therefore, become necessary to identify the actual research needs of the country and to prepare a list of environmental research projects (an Environmental Research Agenda) from which any researcher/research institute could select their research projects.

One of the objectives of this Workshop is to identify, list-out and prioritize the research needs in the environmental sector and facilitate such research through appropriate funding mechanisms. It is hoped that the findings of such research would assist in the formulation of policies, laws and regulations in the environmental sector. The findings/outcome of such research would also facilitate any future review of the National Environmental Standards, formulation of environment policies and information for development for an effective monitoring mechanism etc,.

Therefore, this attempt would provide an overview of available research areas, considering the gaps and areas inadequately addressed that need to be fulfilled in the future.

Resolutions & Recommendations:

1. Recognizing the mandate of the Research & Special Projects (R&SP) Unit of the Environmental Management & Assessment (EM&A) Division of the Central Environmental Authority (CEA), participants agreed upon its role at the National level with regard to :

   I. Co-ordination of environmental research
   II. Prioritization of research areas, and
   III. Facilitating financial support in consultation with the Ministry of Forestry & Environment
   IV. Dissemination of researched information

2. Having recognized that the co-ordination of environmental research activities is one of the already developed set of objectives of the Unit, and having considered the national role of the R&SP Unit of the CEA, the participants supported and encouraged the

   I. Further development of the prioritized research agenda on environmental research prepared by the R&SP Unit,
   II. Expansion of the preliminary database by way of electronic networking with other national organizations such as the National Science Foundation (NSF), to provide access to available information,
   III. Establishment of working committees and thereafter having these committees convened and co-ordinated by CEA, and
   IV. Mobilization of local & foreign funds in consultation with the Ministry of Forestry & Environment in co-ordination with other relevant research organizations
   V. Development of a mechanism to disseminate researched information among end users. A suitable process could be developed (improved and updated over time), in consultation with a Technical Review Committee appointed for each sector, as mentioned under III above.

The recommended implementation activities

These included the following :

1. Preparation of an agenda for short and long term research and making it available to leading researchers, agencies, universities etc;
2. Obtaining the services of a consultancy firm/individual to carry out an analysis and synthesis of environmental research topics available
3. Formulation of a National Policy & setting up of a mechanism to collect, store, disseminate and retrieve environmental information in the form of data, maps, etc,
4. Preparation of a directory on
   - Research findings
   - Research activities completed as well as ongoing
   - Information to be made available on the CEA website

5. Arranging funds
   - Through research grants
   - Donors
   - Govt. funds allocated under various ministries

6. CEA to work as the forum for environmental research
7. Formation of working committees for key environmental issues and each committee to be co-ordinated by a CEA staff officer in order to

- Carry out new programmes at national level
- Facilitate proposals from individuals/groups
-

8. Using the findings of such environmental research in policy formulation
9. Dissemination of research findings among the general public including the end users.

PART II: WORKSHOP PROCEEDINGS

Technical Session:

Chaired by Prof. Sarath Kotagama, Professor of Environmental Science, University of Colombo

Prioritization of Environmental Research Needs in Sri Lanka

"Information fuels change". To have effective positive change, "accurate" information becomes a necessity. The means to obtaining accurate information is 'research'

The environment is a vast subject, needing a large number of persons who seek this information. Through the years it has become clear that as we obtain more information, we raise more questions which require answers. Thus we note that seeking information is an endless task.

Today we are all seeking to achieve 'sustainable development'. This task requires a large amount of information on the environment. It also defines the research strategies to be integrated with social sciences and economics. Achieving sustainable development requires a true mix of ecology, sociology and economics. Asking the 'right questions' thinking along 'win-win' pathways, and looking for 'bright ideas' are directions to sustainable development. This requires innovative research.

The CEA in its role as a facilitator, and as the agency which is the 'Environment Focal Point', has therefore the responsibility to create the required environment to achieve research for sustainable development. This seminar is partly to inform scientists of these objectives and also to seek directions for facilitation from scientists. CEA, as a regulatory body requires some specific information too. This we hope will also become the agenda of research. Through a joint interactive approach we should achieve the desired goal in research priorities for sustainable development.

PREAMBLE

LAND RESOURCES OF SRI LANKA

The total extent of land available in Sri Lanka is 6.56 million hectares. Of this 1,18,000 hectares of land is covered by inland waters. At present, the population of Sri Lanka is 19 million, while the population density is approximately 300 per sq. kilometre. Sri Lanka has three different types of geological regions. The first is the highland complex consisting of the Kadugannawa complex, which occupies the rugged high ground forming the central part of the island and most of the southwestern sector. The second is the Wanni complex consisting of the northwestern, north and northeastern sector. The third consists of the Vijayan complex which includes the eastern and southeastern sector.

It has been recognized that Sri Lanka has fourteen different types of soil which support the country's rich diversity in respect of fauna, flora, etc. The country's Dry Zone contains Reddish Brown earth with important soil groups such as Low Humic Gley soil, Non Calcic Brown soil, Red Yellow Lateritic soil and Alluvial soil. In the Wet Zone the common soil is Red Yellow Podzolic Soil. Other soil types are Reddish Brown Earth, Brown Loam and Bog and Half Bog soil (in marshes).

The main factors affecting land use and land use patterns in the country are the availability of sunlight, water, atmospheric conditions (wind, temperature) etc.

Sri Lanka has a tropical climate and monsoonal seasonal rainfall. Two monsoonal periods and inter monsoon periods are the major determinants of the rainfall pattern of the country. The seasonal pressure build -ups, wind pattern, rainfall variability and the atmospheric temperature also have significant impacts on the climatic conditions which prevail in the country. .

At present Sri Lanka has approximately 2.0 million ha of forest land, which consist of areas which are declared protected by the Department of Wildlife Conservation and the Forest Department, while the rest of the forest reserves are administered by the District and Divisional Secretaries. Altogether, the total forest land area is almost 30% of the land area of the country. In considering the total forest area (30% or 2.0 million ha.) it is possible to calculate the total land area which cannot be utilized for any economic activity. Such land area is approximately 3.025 million hectares, and consists of rivers, streams, reservoirs, seasonal inundated areas, steep lands, lands above 1,525 m contour, barren lands, mangroves and marshy wetland areas. Therefore it can be calculated that the total land area available for direct economic use is around 3.5 million hectares which is equivalent to 53% of the total available area. The extent of land used for paddy is 750,000 hectares while the extent of land used for other minor crops is around 90,000 hectares. The total land area already utilized for main export plantations is approximately 796,000 hectares. However one important feature of the land ownership aspect in Sri Lanka is that 82% of the land area comes under State control.

Formulation of strategies and policies in regard to land use needs to be considered a priority area. Indiscriminate forest clearing has caused serious problems relating to erosion and siltation. Unplanned land use and ill-planned development have created surface and groundwater shortages as well as contamination, while the indiscriminate reclamation of low-lying areas such as paddy land, wetlands and mangrove areas has created a serious threat to bio-diversity as a whole. Our responsibility is to ensure a reasonable balance between optimization of benefits from land use and its sustainable utilization.

Presentation by Group I (Land Resources):

GROUP 01- Land Resources

LAND

ISSUES

Loss of land cover
Limited land availability
Land use patterns, planning, land management
Land use & land cover change

OPERATIONAL

1. Loss of top soil / erosion
2. Soil productivity & fertility
3. Mining of earth mineral resources (exploitation)
4. Absence of land rehabilitation
5. Weak law enforcement
6. Land use patterns & practices
7. Lack of monitoring & rationalizing land use change
8. Inequitable distribution of the benefits of land resource development (E.g. hydro, thermal, highways)

Policy & Institution

1. Absence of land use policy
2. Lack of institutional commitment
3. Lack of vision on long term planning
4. Globalization
5. Absence of a national borrowing policy
6. Lack of professional & scientific land resource management.
7. Politicization
8. Inadequacy of information on impact assessment

List of Participants in Group I (Land Resources):

Mr	W M G B	Giragama
Mr.	P K	Kotta
Dr.	J I	Samarakoon
Mr.	Duminda	Balasooriya
Mr.	K M A	Kendaragama
Ms	Manel	Jayamanne
Dr.	S M C U P	Subasinghe
Mr.	S	Somaratne
Ms.		Dulcy
Mr.	R	Wickramasinghe
Mr.	P K S	Mahanama
Dr.		Wimaladasa
Mr.	H D	Ratnayake
Mr.	Samantha	Gunasekara
Mr.	S A N S	Subasinghe
Mr	A P	Gunawardene
Mr	V S R	De Mel
Mr.	A U K	Ethugala
Mr.	A A	Weerakoon
Mr.	Bhathiya	Sumithraarachchi
Ms	Padmini	Batuwita
Mr	D	Kariyawasam
Mr.	Y B M S	Yapa Bandara
Mr.	Nihal P	Wijesundara

PREAMBLE

WATER RESOURCES OF SRI LANKA

Sri Lanka is situated between 9^0 50'N North and South 5^0 55'N East 81^0 53 E and West 79^0 42'E and is characterized by a tropical climate; high temperature throughout the year in lowland areas (average 27^0 C) and moderate temperature in highland Nuwara Eliya area (average 12^0 C). Sri Lanka's climate is affected by two monsoonal rainfall effects, i.e. the North-East and South-West from which the country receives an annual average rainfall of about 1,300 mm in the Dry Zone and 3,000 mm in the Wet Zone. (Dry, Wet and intermediate zones are the three distinct climatic regions created due to this rainfall pattern). This condition supports and sustains healthy and satisfactory environmental conditions within the country.

The majority of Sri Lanka's land has natural groundwater recharging systems with a radial network of 103 rivers, which originate in the central hills. "Sri Lanka receives about 120 million ha. meters of water annually from rainfall, of which more than 50% is lost through evaporation. Another 20% seeps down to replenish groundwater. Only 30% or about 3.5 million hectare meters is available as stream flow for irrigation or other purposes". (Page 4, Natural Resources of Sri Lanka).

According to historical records, our ancestors were very keen on self sufficiency in agriculture. They constructed more than 10,000 tanks and reservoirs as a cascade system to establish ground water recharging and thus ensure a continuous water supply for irrigation / agricultural purposes. This is commonly referred to as a "hydraulic civilization. This has continued and we can see large scale development of water resources for irrigation and generation of hydropower, specially under Mahaweli Development programmes.

The groundwater aquifer becomes increasingly thicker as they reach the coast in Northern and North Western Sri Lanka stabilizing higher aquifer levels than in other parts of the country. Therefore, groundwater usage using dug wells is also high in that region. Groundwater has been used for irrigation purposes in the Jaffna and Vavuniya districts in particular.

The quality of groundwater in most areas of the country is reasonably good. However, high fluoride contents are found in water in certain areas such as Anuradhapura, Polonnaruwa and Hambantota. In hard, rocky and alluvial areas there is a problem with groundwater on account of the high concentration of iron. Beside groundwater resources, Sri Lanka has about 225 springs, of which more than 120 are located in the central highlands.

In most part of the country, water availability is not a major problem. But due to growing economic activities, industrialization, rapid urbanization and continuous human interference with natural resources, water resources are getting depleted as well as polluted. Biological contamination of groundwater is a common problem in many regions. Groundwater is becoming highly vulnerable to pollution/contamination wherever the soil is thin or absent.

In Sri Lanka, water resources are not adequately protected, conserved or managed. Some limited elements of water management can be seen only in irrigation, hydropower and pipe-borne water supply schemes. However, with the increasing demand for water for many human activities and the increasing rate of pollution, the threat to our water resources as a result of the contamination ratio of groundwater is rapidly increasing, and the degradation of watersheds is also taking place. As a result, we have to contend with a number of problems such as soil erosion, sedimentation of reservoirs, flooding and drought.

Water pollution due to salinisation and discharges from domestic, agricultural and industrial waste is a major problem affecting surface water in most areas. These problems ultimately lead to

health hazards arising from chemical and biological contamination. Over-utilization and heavy contamination of groundwater due to human activities are also growing threats to water resources.

It is important to realize that our invaluable water resources should be judiciously managed and utilized in order to prevent the water shortages which have been forecast for the coming decade.

Presentation by Group II (Water Resources):

Issue 1. – Depletion & degradation of water resources.

- Expand capacity for water quality monitoring & dispersion modeling
- Compile baseline data on groundwater aquifers and make recommendations for sustainable use (over-exploitation)
- Compile baseline data for selected surface water bodies and identify for appropriate uses.
- Compilation of available data on water quality (quality data)

2. Ambient water quality standards & appropriate use
   - Development of quality standards

3. Comprehensive water quality monitoring & dispersion modeling.

Prioritize sensitive areas
- Coastal marine
- groundwater
- surface water, standing/running
- biological indicators
- Pesticide residues
- bioaccumulation

4. Classification of water resources
- Sensitive to land use patterns /activity
- Pollution assimilation capacity

Priority Areas

- Groundwater/surface water (agriculture, urban, industrial zones)
- Aquaculture - Northwestern , Southern and Eastern belt
- Kelani River – potable/recreational
- Kalu Ganga – potable/recreational
- Mahaweli – System H
- Ma Oya – potable
- Walawe Ganga
- Major reservoirs /eutrophication salinity

List of Participants in Group II (Water Resources):

Mr.	H N R	Wikramaratne
Mrs.	M A S	Perera
Dr.	J M P K	Jayasinghe
Mr.	C	Wariyagoda
Dr.	S	Piyasiri
Mrs.	A U	Amarasinghe
Dr.	M C N	Jayasooriya
Prof.	Y N A	Jayatunga
Mr.	J P	Padmasiri
Mr.	I	Dissanayake
Prof.	E I L	Silva
Dr.(Mrs.)	C D	Jayaweera
Dr.	Ravi	Pereira
Dr.	A M	Mubarak
Dr.	W M G	Seneviratne
Dr.	Ajantha	De Alwis
Ms	Ramani	Ellepola
Mrs.	I T	Gnanasekara
Ms.	C	Panditharatne
Mr	Ajith	Rodrigo
Mr.	Tissa	Jayawardena
Prof.	H D	Gunawardhana
Ms.	Sheela	
Mr.	M J J	Fernando
Mr.	Amal	Samantha

PREAMBLE

SRI LANKAN AIR SHED – IN NEED OF ATTENTION ?!

Dr. Ajith de Alwis[1]

The atmospheric resource of the country is a vital resource. As an island in the Indian Ocean, Sri Lanka has benefited by having a continuous sea breeze, monsoon and inter monsoon winds. We have faced no air pollution episodes of any scale and air pollution is not among the five key environmental issues in Sri Lanka.

This state of affairs, which appears to be acceptable at present, should not always be taken for granted. In recent times, some evidence has surfaced which tends to indicate that the urban environment, especially the air shed in our cities is becoming a cause of concern. A recent case filed in courts resulted in the Government having to publish, as a matter of urgency, standards for fuel and vehicle emissions along with vehicle importation standards. This is mainly due to the fact that the air shed is supposed to be affected negatively by the transport sector. About 1.5 million vehicles are used in the country, and a significant majority of this number contributes to the Colombo air shed by way of emissions. The Sri Lankan industrial sector does not contribute to this problem, though in the past air pollution from the Puttalam Cement Factory was well known of. An action plan termed 'Clean Air 2000' was formulated by the Government of Sri Lanka with the assistance of the World Bank in 1992. The goals and objectives set by the Clean Air 2000 Action Plan have not been completely realised. Unleaded petrol was introduced, but the price differentials and availability restricted its widespread usage.

Continuous ambient air quality monitoring is being carried out with limited resources in two locations since 1996. Most of the studies have been carried out in and around the city of Colombo. Acid rain monitoring has been carried out in cities such as Kandy and Anuradhapura. It is interesting to note that the parameter SO_2 read 0.078 ppm near the Colombo Fort Railway Station, (the maximum value recorded for the period 9th Jan-15th Jan 2000) is currently in excess of the National Ambient Standard (0.08 ppm). For the period 31st Dec to 6th Jan 2001 the maximum recorded for the same parameter was 0.107 ppm. Is this a sign of a deteriorating air shed or a transient phenomenon? A clear answer to this question is not yet available. However, it is important that this monitoring continues and the coverage improved, as it facilitates better decision-making. It is important that attention be paid to this disturbing trend.

The country envisages growth in the industrial sector, and as such, more emissions to the air shed could be expected. Though industry does not currently contribute significantly to air pollution industry has a low level of pollution control wherever such problems exist.

Power generation is also undergoing a rapid transformation with more and more thermal power stations being added to the grid. The Sri Lankan average electrification level stands at approximately 54% and there is the general demand for electrification by all others. With the hydro power potential almost exhausted, it is expected that the future demand will be met by increases in thermal power systems. The demand for electricity is expected to increase at a rate of about 9-10% a year. As such, further emissions to the air shed are inevitable.

Few studies have been carried out in respect of to health effects and air pollution. They have raised many questions (i.e. the Lead in Blood Study carried out at the University of Kelaniya). Unfortunately the number of such studies have been few and far between.

It is necessary to pay due attention to this issue if possible adverse effects are to be prevented/mitigated. Piecemeal solutions would not be appropriate.

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[1] Senior Lecturer, Department of Chemical & Processing Engineering, University of Moratuwa

Current Situation

The transport sector, where the vehicle fleet is growing at the rate of 7-8% per annum, makes the biggest contribution to this problem. LPG conversions are currently taking place within the petrol vehicle fleet, primarily driven by lower fuel costs involved after conversions.

The power sector,operates many thermal plants, which use auto diesel and residual fuels. No cogeneration nor combined cycle plants are yet available, and as such, all these are running at lower efficiencies and are thereby contributing waste heat, gaseous and particulate emissions to the air shed.

Regulatory systems in place

Ambient air quality standards exist
Source emission standards have been formulated and are available in draft stage
The EA1P has formulated a comprehensive set of standards, which include primary, secondary and industry zone standards
Standards for vehicle fuel have been formulated and gazetted and are expected to come into force in 2003
Vehicle importation standards have been formulated and gazetted and are expected to come into force in 2003

The Montreal Protocol Unit of the Ministry of Environment looks after the national obligations as a signatory to the Montreal Protocol. Sri Lanka became a signatory to 'The Montreal Protocol on Ozone Depleting Substances' in 1989. The country is also exploring the country options available under the Kyoto Protocol, and a National Action Plan on Climate Change also exists. These developments are as a result of the country signing the 'The Framework Convention on Climate Change' in 1992.

Research and Development activities

There is a need for improvement in R&D activities as well as improvement in information dissemination. R&D activities are not organized, and research is being carried out in only certain areas of interest to individuals or groups. There is a need for more collaborative types of research involving academia and institutions (both public and private) to ensure that the best use is made of the limited resources available for R & D efforts in this area.

Presentation by Group III (Atmospheric Resources):

Key Environmental issues

1. Acid rain – necessity of a National monitoring plan

A) Air Pollution

2. Extent of air pollutants.

- Primary – islandwide monitoring (CO, NO ,SO_2, particulate matter, ..)
- Secondary – (NO_2, O_3 ..)
- Hazardous

3. Extent of indoor air pollution.
   (organics , radiation, particulates , ..)

Effect on women & children

4. Air pollution & health
   - correlations
   - modeling
   - Impact analysis (economic, social)

B) Noise Pollution

5. Noise pollution

   (a) Mobile (vehicles, aircraft, trains)
   - monitoring
   - emission standards for vehicles

   (b) Ambient Noise
   - noise zone maps

6. Modeling
   - Trend analysis
   - Dispersion

7. Compilation of a GH gas inventory
   - Determination of local emission factors

8. Ground base UV level measurements
   - Health issues
   - Ozone columnar density

II List of Research Requirements

We adopted the list provided with amendments

- Aerosol columnar density
- Ozone columnar density

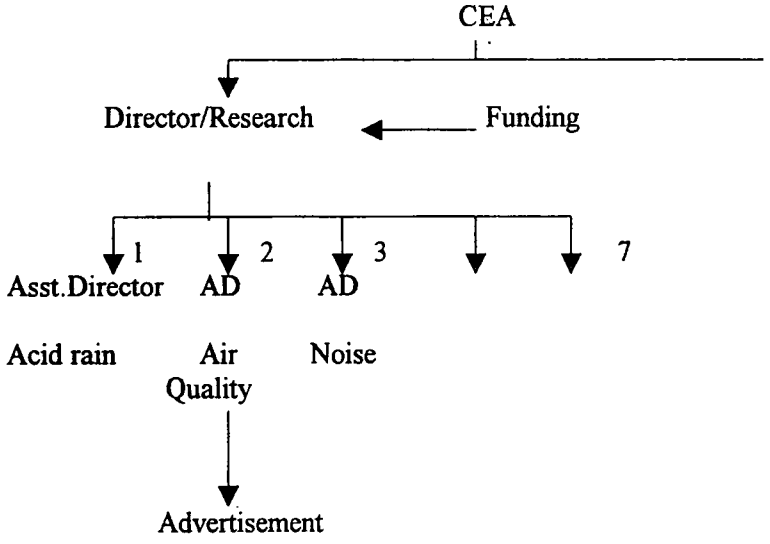
Proposals

1. Formation of a National acid rain monitoring network
2. Formation of an islandwide air quality network (active + passive sampling)
3. Formation of a model to estimate vehicular noise
4. Formation of noise zone maps

Mechanisms

- Formation of sub-committees for key issues identified above, to be conducted by the CEA

TOR – Carry out new programmes at National level
- facilitate proposals from individuals/ groups



Recommendations

1. Preparation of an agenda for short & long term research and make it available to the publi
2. National policy & mechanism to collect, store, disseminate and retrieve environmental information (data, maps)
3. Preparation of a research directory that would contain
   - Available data
   - Research completed, ongoing
   - Information on the CEA website

4. Funding for research
   - Through research grants
   - donors
   - Govt. funds allocated under various ministries.

5. The CEA
   Forum for environmental research

List of Participants in Group III (Atmospheric Resources):

Mr.	Lionel	Jayasinghe
Mr.	K H	Muthukudaarachchi
Dr.	Ananda	Mallawathanthri
Ms.	Nadarajan	Vanmathy
Mr.	H L	Susiripala
Prof.	O A	Ileperuma
Dr.	Janaka	Ratnasiri
Mr.	K G D	Bandarathilake
Mr.	C K	Amarathunga
Dr.	B M S	Batagoda
Mr	Upali	Dahanayake
Dr.	Mahesh	Jayaweera
Mr.	U A P P	Gunawardena
Dr.	K P S C	Jayaratne
Dr.	A P de	Alwis

PRIORITIZING RESEARCH ON THE BIODIVERSITY OF SRI LANKA

Dr. Channa Bambaradeniya[2]

It is well known that Sri Lanka is one of the most biologically diverse countries in Asia. Though being a small island, a wide range of topographic and climatic variations have resulted in a multitude of ecosystems. These ecosystems have, in turn, contributed to an extremely high level of species diversity (Table 1), which is known to be higher than in most other tropical Asian countries, when measured per unit area. Furthermore, isolation from the Indian sub-continent since the late miocene age has led to the evolution of many endemic species. Today, the island is recognized as a 'biodiversity hotspot' of global significance by conservation biologists. Much of this diversity is found in the southwest Wet Zone, which occupies one-third of the country.

Table 1. Species composition of some selected taxonomic groups

Group	Number of indigenous species	% of endemic species
Vertebrate fauna		
Freshwater fish	78	41 %
Amphibians	54	65 %
Reptiles	155	52 %
Birds	226	10 %
Mammals	90	15 %
Invertebrate fauna		
Butterflies	243	8 %
Dragonflies	116	42 %
Freshwater crabs	25	100 %
Land snails	235	84 %
Flora		
Flowering plants	3,750	23 %
Ferns & allies	314	57 %

On the other hand, Sri Lanka also happens to be one of the most densely populated countries in Asia, with approximately 300 inhabitants/km^2. Closed canopy natural forests have been reduced to less than 24 % of the land area of the country. These are least extensive in the Wet Zone where human population pressure is highest. Large-scale deforestation over the past two centuries, together with high human population pressure in this region have resulted in the remaining rain forest cover being reduced to less than 750 km^2. In addition, this is available in highly fragmented patches. A recent analysis on the status of fauna and flora in Sri Lanka conducted by IUCN has revealed that a higher proportion of endemic animals and flowering plants in the island are threatened with extinction. The future survival of our threatened endemic species is heavily dependent on the last bits of rainforests in the Wet Zone, which accounts for just 1.2% of the island's land area. Besides habitat degradation and direct exploitation of species, the spread of alien invasive species in natural and semi-natural ecosystems is a growing threat to native species.

It is under this existing scenario that future research on the biodiversity of Sri Lanka will have to be prioritized. Although there has been a tremendous increase in research activities pertaining to the biodiversity of Sri Lanka during the past few decades, it is important to examine how much of it has really contributed to the conservation of our biodiversity. Considering the latter aspect, there are two important themes that need to be further elaborated by targeted research, viz.

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[2] Head – Biodiversity Unit, IUCN – The World Conservation Union, Sri Lanka Country Office

- How biodiversity could be conserved and maintained within the context of the increasing allocation of land and water resources for human use.

- How natural resources can be managed in a sustainable manner within the context of a growing human population.

Specific issues under these two major themes can be identified through a participatory process, and thereafter we need to determine what has to be done to address each issue pertaining to biodiversity. This will enable prioritization of the research that would contribute to the conservation of biodiversity in Sri Lanka. The success of this attempt would greatly depend on individual researchers, who should work towards achieving results that would benefit the country rather than limit their work to mere academic pursuits.

Presentation by Group IV (Biodiversity, Fauna & Flora, Socioeconomics, Solid Waste Management, Hazardous Wastes, etc):

Theme

BIODIVERSITY

How biodiversity could be maintained within the context of the increasing allocation of land and water resources for human use.

Issues

Fragmentation of natural ecosystems
Loss of specific ecosystems
Loss of Spp.
Spread of alien invasive species

To address the above issues the following steps need to be taken

1. Assess the status of biodiversity in order to identify critical & specific habitats & ecosystems for conservation and sustenance of biodiversity.
   Identify biodiversity indicators & parameters
   - for monitoring of biodiversity
   - for EIAA
   - to identify critical habitat & ecosystems.

2. *Ex-situ* conservation.
   - propagation and rearing techniques
   - Legal research to facilitate ex-situ conservation
   - Evaluation of spp. adaptability
   - Conduct research to identify genetic diversity in selected spp. for construction in gene bank

3. Restoration, enrichment & enhancement of degraded ecosystems & non-natural forests.
   - Method of restoration & enrichment
   - Evaluation of suitable native spp.
   - Identification of suitable areas for restoration & enhancement (research in land use)

4. Use of Biodiversity

High Priority -Determination of sustainable levels of extraction for different uses
ie. timber & non- timber, fisheries & aquatic resources, medicinal plants & ornamental plants.

Low Priority – Risk assessment of genetically modified organisms (GMOO)

L.P. - Research in biotechnology.

L.P. - Integrated pest management (identify bio control agents)

SOCIO ECONOMICS

Sri Lanka recorded 19 million as its population in 1999 and the mid year population growth rate was 1.4 percent. Sri Lanka has a population density of 304 persons per sq. km, one of the highest densities in the Asian region. Sri Lanka's per capita income in 1999 was US $ 829 (Rs. 58,375) and the economic growth rate was recorded as 4.3%. The literacy rate in 1994 in the country was recorded as 92%, which is said to be the highest in the region. Historically Sri Lanka had been an agricultural country. There are three agricultural sectors namely traditional irrigated paddy fields, slash and burn chena practice and home gardens. Rice is the staple food which is cultivated throughout the island. Besides rice, there are other varieties such as pulses, vegetables, coconut and some spice crops that are generally grown in Sri Lanka. Under colonial rule, tea, rubber and coconut were Sri Lanka's main sources of income. This scenario continued for several decades. The Agricultural sector, including forestry and fisheries, has continuously, contributed a major share to the GNP. In 1999, this sectors contribution to the GNP was 20.7%. About 70% of the population is directly or indirectly engaged in agriculture. The main reason for utilizing the country's land for agriculture is due to the fact that nearly 60% of the land area is arable. However, due to under-utilization, mis-management and bad crop management practices a number of socioeconomic as well as severe environmental problems have been created.

As mentioned earlier, the high population density of Sri Lanka has caused a number of problems to the economy and environment in many ways. Housing, health & sanitation, transport and other infrastructure facilities, education and power generation etc, are the major areas that need to be concentrated on economists as well as environmentalists.

Sri Lanka has more than 20,000 villages. Settlement in Sri Lanka cover the whole range, from isolated farmsteads to very small villages, hamlets, towns, cities and densely populated metropolitan regions. However, settlements can be clearly demarcated into two categories viz urban and rural. In 1871 Sri Lanka had a population of only 2.4 million. With the rapid increase of population came fast urbanization which resulted in a high settlement concentration in many areas. In 1999, Sri Lanka's urban population percentage was 24%. According to the results of a census that was taken in 1981, urban occupied housing units stood at 511,810. Rural occupied housing units were 2,084,811. As per available data Sri Lanka has a trend of a high percentage of urbanization. Two main cities, Colombo and Galle, recorded a 60% increase in population over a 35 year period (1946 to 1981). Similar trends were recorded in other main cities too. The distribution of population and population densities are also determined by the industrial profile of the area and access to jobs. Migration is dependent on opportunities for employment available in nearby urban centres, better infrastructure facilities such as transport, telecommunication, better schools for education, health facilities, electricity etc.

However, increases in both population and urbanization create major problems for the country's economy as well as environment. Provision of better housing units and other facilities such as electricity, drinking water, toilet facilities and disposal of solid wastes are today's burning issues. Encroachment of land and construction of shanties & slumps have become social, health and environmental issues. According to a survey conducted by the Urban Development Authority, in 2001 the number of shanties & slumps in Colombo Municipal Council area alone stood at 38,813. Most urban cities are confronted with the problem of solid waste management. The estimated solid waste generated in the Colombo metropolitan area alone is 1,160 mt per day.

Most of the coastal cities in Sri Lanka do not have storm water and industrial effluent discharge systems. They are discharged into the network of streams and canals which are mostly located below or at sea level. Urban waste disposal has affected not only surface water but also groundwater. e.g. textile dying and printing industries have caused widespread pollution in Moratuwa and Ratmalana.

Excess usage of chemicals, pesticides and fertilizers have polluted water bodies as well as groundwater systems.

The socioeconomic conditions of Sri Lanka cannot be isolated from its environmental management process. High expectations for the rapid economic growth of the country can cause serious environmental and economic problems. In order to improve both environmental and socioeconomic conditions it is necessary to adhere to an integrated approach within the management system. Environmentalists recommend strict enforcement of existing laws and the strengthening and improvement of institutional efficiencies with better guidance for balance and sustainable development. Due to misunderstanding and mis-management natural resources are misused, and as a result cause serious environmental impacts that have been experienced in the past. Therefore what we need today is an improvement in environmental education and awareness and an integrated approach to the development process. It is also necessary to adopt new levels of training and analytical abilities to develop mechanisms that would help identify information gaps in order to prioritize environmental management needs.

Theme

How natural resources can be managed in a sustainable manner within the socioeconomic context of Sri Lanka.

Research on methods of mobilizing stakeholder communities for the sustainable use of natural resources.

- Improve & maintain a database on valuation of natural resources & environment
- Make the local community a beneficiary
- Eco. incentives to promote conservation
- Alternative employment opportunities
- Value addition to local products
- Marketing of products
- Identification of alternative products
- Indigenous use of biodiversity
- Study & monitor the impact of eco. policy on biodiversity
- Restoration on biodiversity prospecting
- Environmental trade
- Clean development mechanism

Agencies

Biodiversity

- Forest Dept.
- DWLC
- NARA
- Agriculture Dept.
- Universities
- NGOs
- Research Institutes
    - CRI
    - RRI
    - SRI
    - TRI
    - PRI
- International Organizations (IWMI, IUCN)

Only a few items form the list have been carried out

OTHERS

- Research on minimizing the usage of polythene
- Alternative for polythene
- Data collection & publication on the topic of hazardous waste
- Identification of lands for the disposal of Municipal Solid Waste & hazardous waste

List of Participants in Group IV (Bio-diversity, Fauna & Flora, Socio-economics, Solid Wastes Management, Hazardous Wastes, etc):

Mr.	S P	Vidanage
Mr.	A	Hettiarachchi
Mr.	D S P	Pushpakumara
Dr.	H M	Kodisinghe
Mr.	A	Wijesooriya
Dr.	B F A	Basnayake
Prof.	H B	Kotagama
Dr.	K U	Tennakoon
Ms.	Chandanie	Edussuriya
Mr.	L C de S	Wijesinghe
Prof.	S W	Kotagama
Mr.	W M	Thurul
Dr.	Channa	Bambaradeniya
Dr.	Eric	Wikramanayake
Mr.	Sanath	Ranawana
Dr.	R A D B	Samaranayake
Mr.	M P A U S	Fernando
Dr.	M T N	Fernando
Mr	B G	Wijepala
Mr	Gamini	Gamage
Dr	B	Fernando
Dr.	F P	Amerasinghe
Dr.	Sumith	Pilapitiya
Mr.	G	Jayasinghe
Mr.	Sampath	Jayasinghe

Prioritized Environmental Research Agenda as agreed upon at the Workshop held on 20.12.2000 at Trans Asia Hotel, Colombo

Land Resources (Group I)

Members of Group 1 carefully perused the research list prepared by the CEA and adopted the list with a few additions. The following is the list of priority areas falling under land resources.

- Impact of major land use practices in different agro-ecological zones such as land degradation
- Development of key indicators to assess land suitability. For ex: site classification for forest species
- Development of a GIS- based Land Resources Information System (LRIS)
- Soil quality as a consequence of agronomic practices (adopted by various crop sectors) and industrial effluents.
- Development of mechanisms for the eradication of invasive species
- Identification and assessment of mineral resources
- Effects of mining on air quality, health & safety, ecology & geological stability. e.g. dolomite, granite and metal mining
- Designing of pilot projects for land rehabilitation (e.g. test scientific principles suitable for rehabilitation, its cost effectiveness, pay back period etc.)
- Study on soil and groundwater quality as a result of haphazard landfilling in the form of garbage and industrial wastes
- Post effects of landfilling on wetlands and other environmentally sensitive areas
- Impacts to human health and environment on the erection of telecom towers (if any)
- Groundwater fluctuation due to land cutting (soil excavation)
- A study on the present status of the quarry mining industry, related environmental issues and identification of other potential sites
- Groundwater fluctuation due to sand mining
- Groundwater contamination due to abandoned clay, or coral pits
- Alternative ways of rehabilitating mined lands
- Preparation of an inventory of all mini-hydro power projects installed in Sri Lanka and a study on the downstream environmental impacts
- Identification of suitable land areas for restoration & enhancement of plantation forests

Water Resources (Group II)

As far as the water resources sector is concerned, depletion and degradation of water resources are considered the key environmental issues confronted today. Emphasis must be laid on the urgent need to expand the capacity for water quality monitoring & dispersion modeling, and the compilation of baseline data on groundwater aquifers. Recommendations need to be made for their sustainable use. It is also necessary to compile baseline data on selected surface water bodies and identify them for appropriate uses, as well as make a compilation of available data on water quality (quality data).

The development of ambient water quality standards based on appropriate use; comprehensive water quality monitoring & dispersion modeling by giving priority to sensitive areas like coastal marine, groundwater and surface water (standing/ running, fresh/brackish/marine); starting field studies on biological indicators, pesticide residues, environmental impacts of pesticide use on water resources, bio-accumulation, impacts of climate changes on coastal regions; and classification of water resources based on sensitivity to land use patterns /activity and pollution assimilation capacity were also identified as priority areas.

In selecting localities for launching research studies, Group 2 considered that the following rivers/Oya be given priority.

- Groundwater/surface water (agriculture, urban, industrial zones)
- Aquaculture - Northwestern , Southern & Eastern belt
- Potable water
  - Kelani River
  - Kalu Ganga
  - Ma Oya
  - Walawe Ganga
- Irrigation waters
  - Mahaweli & other river basins
- Major reservoirs
- Major reservoirs /eutrophication, salinity

Group 2 adopted further that research should also be carried out in the following broader areas;

- Development of improved
  (i) sampling techniques
  (ii) analytical methods
- Identification of bio-indicators
- Development of cost effective treatment techniques
- Re-use / recycling of water

List of research identified by the CEA;

- Development of ambient water quality standards based on designated users
- Development of water quality guidelines and standards based on users ('variable standards')
- Development of guidelines for classification of water bodies based on water quality/users
- Development of a comprehensive water quality monitoring programme for Sri Lankan water bodies
- Classification of water bodies in Sri Lanka
- Development of guidelines to maintain water quality
- Studies on the pollutant assimilation capacity of water bodies
- Comparative study of water quality of selected water bodies (eg; Dandugam Oya, Walawe Ganga)
- Development of biological indicators for monitoring of water quality
- Monitoring of water bodies in Sri Lanka using biological indicators
- Monitoring of the water quality of coastal areas, lagoons and marshy land.
- Monitoring of pollution in marine water
- Monitoring of ground and surface water quality in rural and industrial areas for the collection of baseline data
- Analysis of pesticide degradation patterns in agricultural areas
- Analysis of the bio-accumulation of heavy metals in aquatic plants and animals (cumulative effect)
- Identification of water resources which are very sensitive to changes in land use activities/ patterns
- Establishment of minimum flows, safe yields and water allocation limits

Atmospheric Resources (Group III)

Members of the Group 3 who looked at the field of atmospheric resources adopted the list prepared by the CEA (indicated below), with additions like aerosol columnar density and ozone columnar density

- Develop islandwide programmes to monitor CO_2 and other green house gasses (CFC, CH_4, N_2O) and implement them
- Develop and implement islandwide programmes on acid rain monitoring (measurements of pH and acidity of rainwater)
- Collect data on emission sources within the Western Province
- Prepare an emission inventory using the Geographic Information System (GIS)
- Determine metals (eg; Zn/Pb) in ambient air within the Colombo City limits
- Determine Anions such as Chloride, Nitrate and Sulphate in ambient air within Colombo City.
- Determine hazardous air pollutants such as Benzene, Benzopyrene in ambient air within Colombo City
- Determine volatile organic compounds (VOC) around service stations and main roads
- Determine Sulphur Dioxide and Nitrogen Dioxide emission levels within major thermal power stations such as Kelanitissa, Sapugaskanda and Lindel Estate (Asia Power Pack) thermal power plants and any other proposed plants (private/public)
- Determine dust emission levels from Digana dolomite crushing plants. Ambient dust level monitoring in the Digana area.
- Prepare noise zone maps for selected local authority areas.
- Determine ground vibration and a air blast over pressure at multi bore hole quarries in specific areas.
- Determine Sulphur Dioxide concentration in ambient air at specific industrial areas eg. Sapugaskanda area.
- Develop a comprehensive air quality monitoring programme for Sri Lanka and compare findings with National Ambient Air Quality Standards
- Develop Air Pollution Index for Colombo City consisting of the following parameters:

  SO_2 - Low concentration measurements using chemical absorbents
  SPM – high volume sampler
  Pb, Zn, (AAS – graphite furnace)

  Sources:

  Vehicular emission
  Industrial emission

  The above index can be used to control air pollution in Colombo, forecast the distribution of air pollution in the Western Province and remote areas, maintain a database of accurate air quality data for Colombo City, and assess the effects during monsoons on the air quality of Colombo City
- Determination of process of dioxin in the urban atmosphere

Bio-diversity (Group IV)

- Assessment of the status of biodiversity in order to identify critical & specific habitats & ecosystems for conservation and sustainability of biodiversity.
- Identify biodiversity indicators as parameters for monitoring of biodiversity in the preparation of environment impact assessments (EIA) and the identification of critical habitats

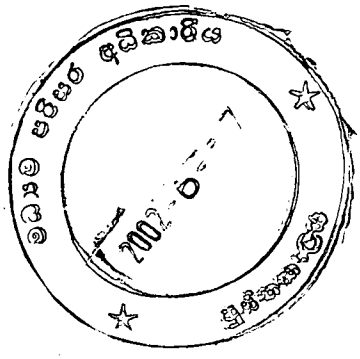
- *Ex-situ* conservation.
    - propagation and rearing techniques
    - Legal research to facilitate *ex-situ* conservation
    - Evaluation of spp. adaptability
    - Identification of genetic diversity in selected spp. for conservation of gene bank
- Restoration- Enrichment & enhancement of degraded ecosystems & plantation forests.
    - Methods of restoration & enrichment
    - Evaluation of suitable indigenous spp.
- Use of Biodiversity
    - Determination of sustainable levels of extraction of biodiversity for different uses. ie. timber, non- timber, fisheries, aquatic resources, medicinal plants and ornamental plants.
    - Risk assessment of genetically modified organisms
    - Research in biotechnology.
    - Integrated pest management (identify bio control agents)

Socio Economics (Also Group IV)

- Research on methods of mobilizing stakeholder communities for the sustainable use of natural resources.
    - Make the local community a beneficiary
    - Eco. incentives to promote conservation
    - Alternative employment opportunities
    - Value addition to local products
    - Marketing of products
    - Identification of alternative products
    - Indigenous use of biodiversity
- Improve & maintain a database on valuation of natural resources & environment
- Study & monitor the impact of economic policies on biodiversity
- Research on biodiversity prospecting
- CO_2 trading (clean development mechanism)

Others Areas (Group IV)

- Research on minimizing the usage of polythene
- Alternatives for polythene
- Data collection & publication of hazardous waste generation, disposal methods and quantities
- Alternatives for coral based lime stone
- Identification of lands for the disposal of Municipal Solid Waste & Hazardous Waste



PART III: ANNEXURES

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Excerpts from the Database developed by the CEA:

Last Name	First Name	Title of the Research	Status
Kotagama	H	A case Study on Extended benefit Coast Analysis on Nilambe Watershed.	Completed
Ranasinghe	M	A case study on the value of waterfalls threatened by the construction of a hydropower project in Sri Lanka.	Completed
Samaranayake	R A D B	A census on the exploitation of sand and seashell resources in the coastal Zone of Sri Lanka	Ongoing
Ranasinghe	M	A comparative study of artificial neural networks and multiple regression analysis in estimating willingness to pay for urban water supply,	Completed
Somaratne	S	A Comparative Study on Soil Carbon Pools under Different Land use patterns in Climatic Zones of Sri Lanka	Ongoing
Kotagama	H	A Hedonic Price Analysis of Consumer Preference on Rice Quality Characteristics	Completed
Ranasinghe	M	A methodology to value and analyze unique natural environmental and / or cultural assets threatened by development projects	Completed
Jayasekara	C	A pilot study on availability of deep groundwater in the Puttalam and Kurunegala Districts for irrigating coconut lands	Ongoing
Gunawardena	Asoka	A Preliminary Investigation on Livestock Biodiversity in Sri Lanka	Completed
Watson	M	A review of the man and the biosphere programme in Sri Lanka	Completed
Perera	M A S	A Study of some selected Industries along the Banks of Dandugam Oya for better environmental management and pollution control	Completed
Weerakoon	T C T	A study on Generation and Use of Solid wastes in the Garment Industry.	Completed
Yapa	P A J	A study on the possibility of converting rubber serum into a fertilizer of slow release type	Completed
Yapa	P A J	A study on the use of rubber factory effluents as a fertilizer for young rubber plants	Completed
Yapa	P A J	A study on the use of water hyacinth in rubber effluent treatment systems	Completed
Samaranayake	R A D B	A survey of the coastal zone of Sri Lanka	Completed
Fernando	C M	Accumulation of selected heavy metals in paddy field sediment and biota.	Completed
Silva	E I L	Acid Rain in Sri Lanka	Completed
Ileperuma	O A	Acid rain monitoring in Sri Lanka	Ongoing
Samarakkody	R P	Activities in the Field of Air Quality Monitoring	Completed
Nayakekorala	H B	Agricultural development potential in the central province of Sri Lanka	Completed
Dharmasena	P B	Agro-forestry in watershed management in agro-forestry for sustainable development in Sri Lanka	Completed
Samarakkody	R P	Air Pollution in Sri Lanka	Completed
Thurul	W M	Air pollution management	Proposed
Samarakkody	R P	Air Pollution Monitoring in Sri Lanka	Completed
Samarakkody	R P	Air Quality Monitoring programme in the Environmental Division of the National Building Research Organization	Completed
Padmasiri	J P	Algal studies in irrigation tanks.	Ongoing
Kendaragama	K M A	Alley Cropping as an alternative to shifting Cultivation in the Dry Zone.	Completed
Karunasinghe	A W J	Ambient Air Quality of the pollution caused by vehicular emission in the city	Completed
Fernando	S T K	An Analysis of Socioeconomic Factors Effecting the Quantity and Composition of Domestic Solid Wastes in the Kandy Municipal Area	Completed

Last Name	First Name	Title of the Research	Status
Fernando	M T N	An assessment of environmental costs due to the non-compliance of effluent standards by desiccated coconut mills.	Proposed
Silva	K A I D	An Assessment on the Optimal Entrance Fee: Udawalawe National Park	Completed
Batagalla	N K	An Economic Assessment of Sustainability of Traditional Agro-Forestry Systems: Case of Kandyan Forest Gardens	Completed
Navaratne	A N	An electro analytical sensor for the detection of Gramoxone (Paraquat)	Completed
Peiris	L D C	Analgesic and sedative effects of methamidophos in rats	Completed
Thenabadu	M W	Analysis of Mahaweli Ganga Water for fertilizer nutrients	Completed
Kotagama	H	Analysis of Social Perceptions on Aesthetic Value of Exterior Architecture of the University of Peradeniya.	Completed
Ranasinghe	M	Analysis of uncertainty in the valuation of cultural and natural assets	Completed
Ranasinghe	M	Analysis of unique natural , environmental and/or cultural assets threatened by development projects: the case of Upper Kotmale Hydropower Project.	Completed
Gunawardhana	H D	Analytical Standardization	Completed
Seneviratne	Y D S	Anthio 33 (an organophosphorus pesticide) on human sperm motility in vitro	Completed
Jayasinghe	J M P K	Aquaculture Sustainability and the Environment - Indo -Pacific region.	Completed
Krishnarajah	S R	Arboreal Sanles in Sri Lanka, states, threat etc and accumulation of toxic substances	Ongoing
Basnayake	B F A	Asian Regional Research Program on Environmental technology. Project on Environmentally Sustainable Solid Waste Management in Asia.	Proposed
Perera	P N S	Assessment of environmental quality and impacts and an environmental management plan for the Biyagama Pradeshiya Sabha area	Ongoing
Samarakkody	R P	Association Between Ambient Air Pollution and Acute Childhood Wheezing Episodes in Colombo	Completed
Navaratne	A N	Atmospheric pollution	Completed
Samarakkody	R P	Automotive Air Pollution in Sri Lanka	Completed
Namaratne	S Y	Behaviour of paraquat in rice soils of the Dry Zone.	Completed
Kotagama	H	Biodiversity Skills Enhancement Project	Completed
Piyasiri	S	Bio indicators in Kandy lake	
Wijesinghe	M R	Bio-accumulation of heavy metals in relation to body length in *Oreochromis mossaambicus*	Completed
Wijesinghe	M R	Bio-accumulation of heavy metals in three species of freshwater fish from Weras Ganga	Completed
Premathilaka	Y S	Bio-accumulation and histopathology of common carp (Cyprinus carpio).	Completed
Wijesinghe	M R	Bio-accumulation of Heavy Metals in detritivorous, omnivorous and piscivorous freshwater fish: Evidence for Biomagnification.	Completed
Liyanage	D D	Biological Oxygen Demand and Chemical Oxygen Demand of the Beira Lake	Completed
Kudaligama	K V V S	Biological waste water treatment	
Jatunarachchi	T S S	Biomethanation as a process waste recycling technique	Completed
Gunawardena	Asoka	Bird diversity of Kiralakelle Wetland	
Ranasinghe	M	Bounds on the value of waterfalls: a case study from a hydropower project.	Completed
Suresh Kumar	N	Build-up of nutrient and toxic metabolites in the grow-out Process of the semi-intensively cultured shrimp pond.	Completed
Gunawardhana	H D	Chemical education in Sri Lanka	Completed
Priyantha	Namal	Chemically modified electrodes for detection of clinically important compounds	Completed

Last Name	First Name	Title of the Research	Status
Jinadasa	J	Clams of the Negombo Estuary	Completed
Ranasinghe	M	Clay mining for building materials : future land use,	Completed
Ranasinghe	M	Clay mining for building materials:	Completed
Ranasinghe	M	Clay mining for building materials: feasibility and environmental costs.	Completed
Samaranayake	R A D B	Coastal changes of Crow Island and its environments	Ongoing
Jayasinghe	J M P K	Coastal Resources and Environmental Management in the Northwestern Province of Sri Lanka.	Completed
Jayasekara	C	Collecting, , Characterization, Evaluation and Conservation of coconut genetic resources in Sri Lanka for effective utilization in breeding of the palm	Ongoing
Kotagama	H	Commercial viability of plantation forestry in Sri Lanka	Unpublished
Kotagama	S W	Community Dynamics of mixed species flock feeding in Sinharaja.	Ongoing
Dharmasena	P B	Comparison of environmental richness in natural forest and home gardens: a case study from Nachchaduwa Catchment	Completed
Samarakkody	R P	Comparison of two absorbing reagents for the determination of nitrogen dioxide in the atmosphere	Completed
Samarakkody	R P	Comparison of two methodologies, West and Geake and Pulse Fluorescent for the determination of ambient sulphur dioxide	Completed
Jayatunga	Y N A	Composition, density and distribution of Zooplankton in the Kalawewa H 1 area. Monograph on Limnology and Fisheries of the Mahaweli River basin of Sri Lanka	Completed
Ileperuma	O A	Conducting the M.Sc. Course in Environmental Science	Ongoing
Kotagama	H	Congruence of Ecological and Economic Factors in Forest Conservation for Biological Diversity.	Unpublished
Dharmasena	P B	Conservation farming practices for small reservoir watersheds; case study from Sri Lanka, agro-forestry system	Completed
Kariyawasam	D	Conservation of Bamboo in Sri Lanka Using Genetic Resources for Sustainable Development	Completed
Rizvi	E M J M	Conservation of Medicinal Plants	Ongoing
Kotagama	H	Constraints and Solution to Application of Economic Valuation of Environmental Impacts of Development Projects	Unpublished
Subasinghe	S M C U P	Construction of individual tree volume prediction models for E.grandis in Badulla, Kandy & N'Eliya Districts	Ongoing
Dharmasena	P B	Contour shift mapping technique to assess soil movement	Completed
Namaratne	S Y	Copper and Cadmiun decontamination of waste waters by rice hull ash.	Completed
Jayatunga	Y N A	Correlation between Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) for different industrial waste waters	Completed
Amarasinghe	A U	Correlation between Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) for different industrial waste waters	Completed
Jayasinghe	S	CPI in Sri Lanka: The impact of imports and exports	Ongoing
Gunasekara	Samantha	Database on exports of flora and fauna	
Kotagama	H	Decomposition Analysis on the Effect of Differential Access to Irrigation water.	Unpublished
Navaratne	A N	Detection of herbicides using plant tips based biosensus	Ongoing
Priyantha	Namal	Detection of organic environmental pollutants using electropolymerized metalloporphyrin films	Completed
Jayaweera	C D	Determination of mercury in the Beira Lake (Preliminary investigation)	Ongoing
Dharmasena	P B	Determination of soil erodibility in Rhodustalfs	Completed
Nayakekorala	H B	Determination of water transmission properties in sub soils of Reddish Brown Latosolic soils of Sri Lanka	Completed
Kotagama	H	Development and forest conservation	Unpublished

Last Name	First Name	Title of the Research	Status
Kariyawasam	D	Development Issues and Challenges in Watershed Management	Completed
Jayasinghe	Eranga	Development of a hi-rate biomethanation system	Ongoing
Jayatilake	K A K	Development of a low-cost technology for the treatment of rice mill effluents	Completed
Samarakoon	J I	Development of a Model in Integrated Natural Resources Management	Ongoing
Edirisinghe	U	Development of artificial breeding techniques for some commercially important inland fish species	Ongoing
Thurul	W M	Development of a biological odour filter	Completed
Navaratne	A N	Development of electro analytical and chromatographic methodologies for the detection of select pesticides used in Sri Lanka	Ongoing
Priyantha	Namal	Development of electroanalytical and chromatographic methodologies for the detection of selected pesticides used in Sri Lanka	Ongoing
Ileperuma	O A	Development of materials for abating water pollutants	Ongoing
Basnayake	B F A	Development of sanitary composting for solid waste management in Urban Local Authorities.Stage I - pilot units in Mawanella PS, Dambulla PS, Kalutara UC, Kataragama PS	Ongoing
Gunawardhana	H D	Development of sensitive and economical analytical methods for the determination of some water quality parameters such as Chemical Oxygen Demand (COD) etc,	Ongoing
Ranasinghe	M	Domestic water tariff in Sri Lanka :have we got it right	
Bambaradeniya	Channa	Ecological assessment of the Madu Ganga Wetland Ecosystem	Ongoing
Kotagama	H	Economic Development and Forest Management: An Empirical Analysis.	Unpublished
Kotagama	H	Economic incentives for biodiversity conservation and sustainable use	Unpublished
Herath	H M B S	Economic Management of Eppawela Phosphate Deposit, Sri Lanka: An Empirical Application.	Completed
Kotagama	H	Economic Policy Options to Conserving Biodiversity: The Case of Medicinal Plants.	Unpublished
Kotagama	H	Economics of Agro-forestry: A Case Study in Kandy	Unpublished
Kotagama	H	Economics of Land Use: A Case Study on the Knuckles Forest Management Plan.	Unpublished
Gunasekera	M Y	Effect of anti-microbial discharges into wastewater treatment plants in the pharmaceutical industry	Completed
Seneviratne	Y D S	Effect of carbofuran (a carbomate pesticide) on human sperm motility in vitro	Completed
Rizvi	E M J M	Effect of carbon substrate supplementation on associative dinitrogen fixation on Rice	Completed
Piyasiri	S	Effect of catchment practices on Eutrophication and blooming of the Kandy Lake	
Jayaratne	K P S C	Effect of climate on productivity of tea	Ongoing
Dharmasena	P B	Effect of communal use of Dry Zone forest land on soil erosion	Completed
Nayakekorala	H B	Effect of length of land preparation period on water use, weed growth and grain yield of lowland broadcast rice	Completed
Gunawardhana	H D	Effect of Man's activities on the deterioration of the Quality of Irrigation Waters	Completed
Nayakekorala	H B	Effect of paddy straw mulch on seedling emergence of some legumes grown on Reddish Brown earths	Completed
Liyanage	D D	Effect of pollution on distribution of Zooplankton in the Beira Lake	Completed
Kariyawasam	D	Effects of Economic Development on the Extraction of NTFP among the communities of Sinharaja	Completed
Peiris	L D C	Effects of Methamidophos on the reproductive system of male rats.	Completed
Wickramasinghe	D D	Effects of nitrite on histology of selected organs of juvenile common carp (*Cyprinus carpio*)	Completed
Priyantha	Namal	Electrochemical detection of biologically important compounds with metalloporphyrin coated electrodes	Completed
Jasinghe	S R	Emission inventory for the Sapugaskanda Industrial Area	Completed

Last Name	First Name	Title of the Research	Status
Perera	P W A	Environmental Aspects of the Pig industry in the Gampaha District and the role of Micro-organisms in Pig Waste Management.	Proposed
Jayasinghe	J M P K	Environmental Assessment and Management of Shrimp Culture Development.	Completed
Ranasinghe	M	Environmental bond for clay mining in Sri Lanka	Completed
Ranasinghe	M	Environmental costs and benefits to the economic feasibility of the Kukule Ganga Hydropower Project	Completed
Kotagama	H	Environmental Economics Education in Sri Lanka	Completed
Kotagama	H	Environmental Education in Sri Lanka.	Unpublished
Kodisinghe	H M	Environmental Health specially on vector borne diseases	Completed
Periyapperuma	S P	Environmental Impact Identification and a possible mitigating strategy for the Borelasgemuwa Lake	Ongoing
Namaratne	S Y	Environmental implications of tannery waste in the Kelani estuarine water.	Completed
Ranasinghe	M	Environmental Management Systems on Construction Sites in Sri Lanka	Ongoing
Dias	S	Environmental management tools for urban shelter development	Ongoing
Dharmasena	P B	Environmental richness in the Dry Zone homegardens	Completed
Basnayake	B F A	Establishment and operation of a solid waste management research unit.	Ongoing
Samarakkody	R P	Establishment of an Air Pollution Monitoring Network in Colombo	On going
Tennakoon	K U	Establishment of high value Santalum album tree farm systems with community participation	Ongoing
Basnayake	B F A	Establishment of a Solid Waste Management Laboratory	Proposed
Dharmasena	P B	Estimating runoff from small agricultural lands	Completed
Ranasinghe	M	Estimating willingness to pay for urban water supply: a comparison of artificial neural networks and multiple regression analysis.	Completed
Priyantha	Namal	Etalloporphyrin coated electrodes as sensors for pesticides	Completed
Piyasiri	S	Eutrophication and blooming in the Kotmale Reservoir	
Silva	E I L	Eutrophication of the Kandy Lake	Completed
Priyantha	Namal	Evaluation of tree species as potential candidates for metal iron uptake from polluted water	Ongoing
Navaratne	A N	Evaluation of agriculturally important water quality parameters of the Ketawala Anicut located in the Gampaha District	Completed
Kendaragama	K M A	Evaluation of the capacity of Biological soil erosion control measures on sloping lands.	Ongoing
Fernando	B	Ex-situ conservation of ferns of Sri Lanka for future usage	Ongoing
Padmasiri	J P	Excess fluorides in drinking water in the Dry Zone.	Completed
Ranasinghe	M	Extended benefit cost analysis: Quantifying some environmental impacts in a hydropower project.	Completed
Yapa	P A J	Extraction and purification of quebrachitol from Hevea latex serum	Completed
Dharmasena	P B	Farming packages to improve catchment hydrology of village tanks	Completed
Ranasinghe	M	Feasibility and environmental impacts of clay mining of Sri Lanka	Completed
Thiruchelvam	A T	Feasibility study on waste oil disposal in cement kilns for Sri Lanka	Completed
Rajapakse	I K	Feeding preference (grazing: browsing) and grazing pressure of sambhur deer (*Cervus unicolor unicolor*)at the Horton Plains National Park, and grassland productivity of the Horton Plains National Park.	Completed
Hettiarachchi	A	Fisheries of Villus in the Mahaweli River system of Sri Lanka.	Completed
Kotagama	H	Forest and biodiversity conservation	Unpublished

Last Name	First Name	Title of the Research	Status
Gunatilleke	I A U N	Forest Biology in Lowland Rain forests of Sri Lanka	Ongoing
Kotagama	H	Forest Management at Crossroads: Forestry Sector Master Plan,1995	Completed
Dharmasena	P B	Grass hedge can replace the bund in soil conservation	Completed
Dharmasena	P B	Grass-tree, hedgerows: an improvement to alley cropping	Completed
De Silva	S	Greenhouse Mitigation value of Sri Lankan Forests. Rationale for International Resources Transfer.	Completed
Widyawardena	U K N S V	Groundwater pollution due to industrialization.	Completed
Dharmasena	P B	Groundwater potential in minor tanks and watersheds of Sri Lanka	Completed
Dharmasena	P B	Groundwater utilization for crop production	Completed
Kodippili	A A	Groundwater Development for Tangalle water supply scheme - conjunctive use approach	Ongoing
Kodippili	A A	Groundwater Development in Sinimodara Oya Basin and its impacts on the Environment	Completed
Dharmasena	P B	Guidelines for drainage designs for upland farms, Krushi	Completed
Dharmasena	P B	Guidelines for groundwater use in the Dry Zone tank cascade systems in Sri Lanka	Completed
Dharmasena	P B	Harvesting rain water for fruit crop establishment	Completed
Samarakkody	R P	Health effects of vehicular emission in Colombo	Completed
Priyantha	Namal	Heavy metal accumulation by aquatic plants - possible method for metal iron removal from waste water	Ongoing
Nandasena	K A	Heavy metal accumulation in upcountry soils	Completed
Nayakekorala	H B	Hydrological implications of soil water dynamics under an alley cropping system in the mid country Intermediate Zone of Sri Lanka	Completed
Kotagama	H	Identification and Estimation of Priority Weights of Irrigation Systems Management Objectives for Irrigation Systems Performance assessment	Completed
Bambaradeniya	Channa	Identification of critical habitats in the Muthurajawela Wetland Sanctuary	Completed
Giragama	W M G B	Impact Assessment of Kirindi Oya Irrigation and settlement Project.	Completed
Dharmasena	P B	Impact assessment of soil conservation measures in Dry Zone rainfed farming	Completed
Vidanage	S P	Impact of 1998 coral bleaching on coastal communities.	Ongoing
Wijesooriya	A	Impact of community use of natural resources on biodiversity and other conservation as part of forests	Proposed
Jinadasa	J	Impact of fragmentation of aquatic systems on biodiversity	Proposed
Jayawardena	P A H L	Impact of Industry on environmental sulphur dioxide level.	Completed
Amerasinghe	F P	Impact of irrigation water on the biodiversity of fauna and flora in the brackish water lagoons of the Bundala National Park.	Ongoing
Thurul	W M	Implementation of commercial scale waste water treatment systems	Ongoing
Ranasinghe	M	Implementation of Environmental Management Systems in Construction Project Management Organizations in Singapore	Completed
Kotagama	H	Implications of GATT and SAPTA on Sri Lankan Agriculture	Unpublished
Gunawardhana	H D	Importance of Analytical Chemists in Environmental Science	Completed
Kotagama	S W	Important Bird Areas Identification and the Conservation Programme.	Ongoing
Kotagama	H	Improving Decision Making on Development Projects: Role of Economic Valuation of Environmental Impacts.	Completed
Nayakekorala	H B	Infiltration characteristics of soils under different land use systems in the mid country intermediate zone of Sri Lanka	Completed
Kotagama	H	Initiatives on economic valuation of biodiversity in Sri Lanka	Unpublished

Last Name	First Name	Title of the Research	Status
Kariyawasam	D	Institutional Determinants of Implementation Performance in Forestry in Sri Lanka, and Recommendations for Improvement	Completed
Dharmasena	P B	Integrated Management of Water Resources in Tank Village Farming	Completed
Priyantha	Namal	Integrated studies of biodiversity and water quality in an irrigated rice field ecosystem	Completed
Kariyawasam	D	Integration of Forestry and Agricultural Extension Field Documents I & II	Completed
De Silva	S	Integration of the Forest Resource into National Income Accounting.	Completed
Gunawardhana	H D	Interlaboratory comparison of water quality parameters	Completed
Gunawardhana	H D	Interlaboratory comparisons of water quality parameters- An activity through which the interaction of the University with Industry can be achieved	Completed
Gunawardhana	H D	Interlaboratory testing programmes for potable waters	Completed
Jayatunga	Y N A	Investigation of Selected heavy metals in sediment and biota of the Kelani River	Completed
Kotagama	H	Investment Analysis of Agricultural Education	Completed
Namaratne	S Y	Iron exchange and redox liabilities of sediment bound heavy metals of the Kandy Lake.	Completed
Kotagama	H	Irrigation Systems Performance Assessment Methodology.	Unpublished
Ranasinghe	M	ISO 14000 Practical Implication for the Construction Industry. Case study in Singapore, Total Quality Management in Construction: Towards Zero Defect	Completed
Dharmasena	P B	Kattakaduwa; A potential lands for agro-forestry system development in Sri Lanka	Completed
Silva	E I L	Land Ocean , nutrient fluxes – the silica ceyde	Completed
Dharmasena	P B	Land degradation: A threat to agricultural production in the Dry Zone	Completed
Jayasekara	C	Land suitability evaluation for coconut in the coconut growing areas	Completed
Nayakekorala	H B	Land use effects on hydrological process and their implications on watershed management: A study in the mid country intermediate zone of Sri Lanka.	Completed
Dharmasena	H A	Lead levels in air at four selected sites in the City of Colombo	Completed
Jayaratne	K P S C	Lightning protection and hazards	Ongoing
Piyasiri	S	Limnology of Kotmale, Victoria, Randenigala and Rantambe Reservoirs	
Silva	E I L	Limnology of manmade water bodies	Completed
Dharmasena	P B	Long term trend in the rainfall of central Dry Zone	Completed
Dharmasena	P B	Magnitude of sedimentation in village tanks	Completed
Dharmasena	P B	Man-environment interaction in tank-village, home-gardens; the trends in vegetation	Completed
Dharmasena	P B	Management of Rainfed farmland in the Dry Zone of Sri Lanka	Completed
Samarakkody	R P	Measurement of total lead in the atmosphere	Completed
Thurul	W M	Media development for waste water treatment systems	Completed
Namaratne	S Y	Methane emission from rice field in the Kandy District.	Completed
Jinadasa	J	Migration of Prawns in the Bolgoda Estuary	Completed
Ranasinghe	M	Mining restoration bond for clay mining and its impact on the prices of building materials in Sri Lanka	Completed
Dharmasena	P B	Modelling Dry Zone home-gardens	Completed
Bambaradeniya	Channa	Monitoring of alien invasive species in Sri Lanka	Ongoing
Wijeyaratne	S C	Monitoring of Atmospheric quality in Colombo and suburbs using bio-indicators	Completed

Last Name	First Name	Title of the Research	Status
Samarakkody	R P	Monitoring of Lead in ambient air	Completed
Gunawardhana	H D	Monitoring of the quality of waters in the Mahaweli	Completed
Gunawardhana	H D	Monitoring of water pollution in Ratmalana and Moratuwa area	Ongoing
Gunawardhana	H D	Monitoring of the water quality of systems H, B and C of Mahaweli	Completed
Dharmasena	P B	Mulching for water conservation in agro-well farming	Completed
Fernando	M P A U S	Natural vegetation studies in natural forests.	Ongoing
Thurul	W M	New Low cost treatment configurations development	Ongoing
Nandasena	K A	Nitrogen dynamics in Sri Lankan Soils	
Kendaragama	K M A	Nitrogen leaching in a non – calcic brown soil following urea application.	Completed
Jayaratne	K P S C	Noise pollution model for highways	Ongoing
Suresh Kumar	N	Nutrient and metabolic loading from semi-intensive shrimp farming systems.	Completed
Gunawardhana	H D	Optimum use of water resources for development	Completed
Dharmasena	P B	Optimum utilization of the storage in village tanks	Completed
Kendaragama	K M A	Overuse of Chemical fertilizer in intensive farming in Regosols in the Kalpitiya Peninsula.	Completed
Wimalasinghe	H M	Participatory Watershed Management Research Project.	Completed
Nayakekorala	H B	Penetration and activity of soybean roots in Reddish brown earth soils	Completed
Dharmasena	P B	Perennial crop forest; Another dimension in the Dry Zone forestry development	Completed
Tennakoon	K U	Performance of selected non-timber forest species in the Sinharaja World Heritage Site, Sri Lanka	Ongoing
Nayakekorala	H B	Physical and Chemical characteristics of eroded soils in the mid country of Sri Lanka	Completed
Basnayake	B F A	Pilot & Demonstration compost unit for development & operation of sanitary compost plants for urban solid waste management	Completed
Silva	E I L	Plankton diversity	Completed
Dharmasena	P B	Planning strategies for crop diversification in minor irrigation schemes	Completed
Padmasiri	J P	Pollution levels in Ma Oya :Sabaragamuwa District	Completed
Padmasiri	J P	Pollution levels in Mahaweli River, Kandy Region	Completed
Kotagama	H	Population Environment and Development Linkage: An Empirical Analysis on the Forestry Sector in Sri Lanka.	Completed
Rajapakse	I K	Population estimation of sambhur deer (*Cervus unicolor unicolor*)in the Horton Plains National Park.	Completed
Wijepala	S	Positive environmental management via waste minimization for a textile washing factory	Completed
Jayatilake	G M	Possible Adverse Effects on the environment due to uncontrolled groundwater abstraction and utilization in crystalline basement areas of Sri Lanka: A case study from the Anuradhapura District Sri Lanka	Ongoing
Vidanage	S P	Potential and Factors Affecting eco-tourism in Sri Lanka	Completed
Dharmasena	P B	Potential runoff and soil movement in a Rhodustalf	Completed
Navaratne	A N	Preliminary evaluation of water quality parameters of irrigaiton water located at "Ketawala Anicut" in the Gampaha District	Completed
Perera	P W A	Preliminary Investigation of Communal Roosting at Vitiyala.	Completed
Gunawardena	Asoka	Preliminary Investigation on Communal Roosting at Vitiyala	
Wijeyaratne	S C	Preliminary studies on Microbial pollution indicators in aquatic ecosystems with special reference to Bolgoda Lake	Ongoing
Dharmasena	P B	Present status of minor tank and agro-well farming	Completed

Last Name	First Name	Title of the Research	Status
Dharmasena	P B	Present use of land and water resources in village tank farming	Completed
Nayakekorala	H B	Profile distribution of extractable phosphorus following knife applied sub-surface fertilizer band	Completed
Fernando	M P A U S	Propagation and cultivation of mangroves species	Ongoing
Tennakoon	K U	Propagation, Agronomic and Farming System Research on four Medicinal Plant Species (*Santalum album*, *Coscinium fenestratum*, *Hemidesmus indicus* and *Piper longum* of Sri Lanka)	Ongoing
Kendaragama	K M A	Quality of Agro-Well Water in the Dry Zone	Completed
Dharmasena	P B	Rainfall erosivity and potential erosion in the central Dry Zone	Completed
Kotagama	H	Rationale on Biodiversity Conservation.	Unpublished
Ranasinghe	M	Reconciling private profitability and social costs: the case of clay mining in Sri Lanka.	Completed
Kotagama	H	Redefining Intermediate Technology: Seeking Congruence with Sustainable Development	Unpublished
Samarakkody	R P	Removal of dye using tamarind	Completed
Samaranayake	R A D B	Report on the inventory of places of religious and cultural significance and areas of scenic and recreational value within the coastal zone of Sri Lanka	Ongoing
Kotagama	H	Research Under Scarcity	Unpublished
Kariyawasam	D	Resource Use and Settlement in the forests of the Knuckle's Range	Completed
Dharmasena	P B	Resources management studies on agro-well farming in the Dry Zone in Sri Lanka	Completed
Nayakekorala	H B	Root activity patterns of some upland crops grown in Reddish Brown earths	Completed
Samarakkody	R P	Sampling of air	Completed
Samaranayake	R A D B	Shoreline erosion in Sri Lanka's coastal area	Ongoing
Subasinghe	S M C U P	Site classification of E. grandis plantations using chemical properties	Ongoing
Kariyawasam	D	Social Dynamics at the Forest Edge: A Changing Frontier in the National Heritage of Sri Lanka	Completed
Gunasena	H P M	Socioeconomic Acceptability of Casuarina for Coastal Conservation.	Completed
Kotagama	H	Socioeconomic Aspects of Advanced Irrigation Technologies in Developing Countries	Completed
Nayakekorala	H B	Soil degradation status of Sri Lanka	Completed
Dharmasena	P B	Soil erosion control measures for rainfed farming in the Dry Zone of Sri Lanka	Completed
Dharmasena	P B	Soil moisture as a production constraint in fainfed agriculture	Completed
Samarakkody	R P	Some aspects of air pollution in Colombo City	Completed
Jayakody	Sevvandi	Some aspects of Ecology and behaviour of mammalian carnivores of Sri Lanka	Proposed.
Rajapakse	I K	Some observation of the habits and behaviour of sambhur deer (*Cervus unicolor unicolor*)at the Horton Plains National Park	Completed
Samarakkody	R P	Status of Air Pollution Monitoring in Sri Lanka	Completed
Silva	E I L	Stream Ecology, Nilambe Oya, Kuru Ganga, Mahaweli River	Completed
Nayakekorala	H B	Studies on evapotranspiration of chilli (*Capsicum annum*) in the Dry Zone of Sri Lanka	Completed
Gunawardhana	H D	Studies on the quality of irrigation waters in Kalawewa area	Completed
Gunawardhana	H D	Studies on the use of coconut oil based ligands for the extractive separation of titanium (IV)	Completed
Abeyewickreme	W .	Studies on transmission of Dengue in Sri Lanka and conducting awareness programs on Dengue transmission	Ongoing
Jayatunga	Y N A	Studies on Zooplankton in an irrigation system under the Mahaweli Diversion Scheme	Completed

Last Name	First Name	Title of the Research	Status
Wijeyaratne	S C	Study diversity and distribution of lichen on Ritigala mountain and monitoring of air pollution with respect to SO2	Ongoing
Navaratne	A N	Substituent effects of fluorine on the nonaqueous electrochemistry of Pentafluoroiron (iii) tetraphenyl porphyrin chloride	Completed
Nayakekorala	H B	Supplementary irrigation requirements for early grown lowland paddy during the rainy seasons in the Dry Zone	Completed
Dharmasena	P B	Surface and groundwater hydrology in tank cascades	Completed
Navaratne	A N	Survey of electrochemical activity of some pesticides used in Sri Lanka	Completed
Jayatilake	K A K	Survey of Environmental Technologies used by Sri Lankan Industries	Ongoing
Gunawardena	Asoka	Survey on Bird Diversity in the Southern Province	On going
Basnayake	B F A	Survey on Hazardous Waste Management	Completed
Samaranayake	R A D B	Survey on permit compliance within the coastal zones of Hambantota, Kalutara, Colombo, Gampaha and Puttalam districts	Complete
Jayasekara	Chandrika	Sustainable Agriculture through Education and training for the farm families in Nuwara Eliya and Badulla Districts	Ongoing
Kariyawasam	D	Sustainable Forestry Management in Developing Countries: Experiences from Asia	Completed
Kotagama	H	Sustainable Use of Bio-diversity for Sustainable Development: Economics Options	Completed
Dharmasena	P B	System loss studies of village tanks.	Completed
Dharmasena	P B	Tank village system as a resource base for multipurpose trees	Completed
Kotagama	H	Technical and Economic Rationale of Bethma Institution of Water Management in Sri Lanka.	Unpublished
Jayatunga	Y N A	The composition density and distribution of Zooplankton in Kalawewa H1 areas in Sri Lanka	Completed
Samaranayake	R A D B	The coral and shell industry of Sri Lanka	Ongoing
Dayawansa	P N	The density, distribution and fecundity of Cladocerans in Beira Lake	Completed
Ranasinghe	M	The domestic water tariff in Sri Lanka	Ongoing
Rathnayake	S S K	The effect of ICON (Lamba-Cyhalothrin) on early gestation of rats.	Completed
Steele	P	The significance of coastal resource use (Especially Aquaculture) in the southern area for generating employment and national income	
Kariyawasam	D	The Social Dimension in Watershed Management	Completed
Gunawardhana	H D	The water we drink and the Air we breathe	Completed
Amarasekera	H S	Timber utilization other than fuel wood in the AGA's Division, Horana	Completed
Wijeyaratne	S C	To study distribution and diversity of lichen in Colombo and suburbs	Ongoing
Giragama	W M G B	Topo-climate in Sri Lanka: a case study of the Dumbara Hills.	Completed
Dharmasena	P B	Towards efficient utilization of surface and groundwater resources in food production under small tank systems	Completed
Priyantha	Namal	Treatment of industrial effluents by natural substances	Completed
Dharmasena	P B	Trends in railfall and agricultural production in the Dry Zone	Completed
Jinadasa	J	Trout population in Horton Plains and factors affecting its sustenance	Ongoing
Dias	S	Urban Water Pollution	Proposed
Amarasinghe	S P K	Use Hydrocarbon Refrigerant (LPG) for CFC, HCFC, & HFC as a alternative refrigerant to protect the ozone layer and slowdown globle warming.	Ongoing
Gunawardhana	H D	Use of Chemical Analysis in the detection of problems in large-scale irrigation	Completed
Gunawardhana	H D	Use of dolomite for the finishing coat in Masonry	Completed

Last Name	First Name	Title of the Research	Status
Dharmasena	P B	Use of *Gliricidia sepium* for erosion control in rainfed uplands of the Dry Zone	Completed
Jayatilake	K A K	Use of Information Technology in dissemination of Industrial Environmental Data	Proposed
Yapa	P A J	Use of rubber factory effluents as a source of N,P and K for rubber and paddy plants	Completed
Kariyawasam	D	Using the travel cost method for assessing recreational benefits in a biosphere reserve	Completed
Jayasinghe	J M P K	Utilization of Coastal acid sulphate soils for aquaculture (Shrimp culture)	Completed
Giragama	W M G B	Variation of soil erosion under different physical conditions.	Completed
Samoon	M M	Waste human hair as an oil recovery method	Completed
Wagner-Gillen	Christopher	Waste Minimization through Process Optimization in an edible oil refinery and effluent treatment plant	Completed
Thurul	W M	Waste minimization at production	Ongoing
Seneviratne	W M G	Waste Water Treatment of Rubber & Industrial waste and Bio gas collection Studies.	Ongoing
Dharmasena	P B	Water balance of a tank cascade system in the Dry Zone	Completed
Gunawardhana	H D	Water for Irrigation and extraction of metals	Completed
Gunawardhana	H D	Water for irrigation and extraction of metals	Completed
Nandasena	K A	Water Pollution in Horton Plains	Completed
Dassanayake	H	Water quality of the Hamilton Canal, a man-made water body associated with a coastal wetland of Sri Lanka.	Completed
Gunawardhana	H D	Water quality studies in the Mahaweli River Diversion Scheme	Completed
Jayatunga	Y N A	Water Quality, Water Pollution, bio-accumulation of heavy metals in biota effects of pesticides on rats.	Completed
Mubarak	A M	Watershed Management – Parliament Lake catchment area	Proposed
Ranasinghe	M	Why we should not implement projects like the Upper Kotmale Hydropower Project: risk and uncertainty perspective.	Completed
Ranasinghe	M	Willingness to pay for urban water supply in Sri Lanka	Completed
Giragama	W M G B	Workshop on 'Environmental Education and Training for Sustainable Agricultural Development"	Completed

Terms of Reference for Group Work:

1. Formation of 4 groups (details given below) according to the field of expertise (the list of names under each group has been displayed at the front desk)

2. Each group to appoint a Group Leader and Rapporteur

3. Each group to identify the key environmental issues confronting the country, under the respective subject areas

4. Each group to study the following documents

   a) A list of research requirements identified and prepared by the Central Environmental Authority.

   b) A list of ongoing and completed research projects prepared by the Central Environmental Authority, based on information collected through an islandwide survey (only the relevant area pertaining to the group is included[2])

5. Determine whether the completed, ongoing, and proposed research studies address the issues identified under # 3 satisfactorily.

6. Comment on the scope and scale of the research projects already undertaken and determine the adequacy of such research in addressing the problem/ issues

7. List out gaps, and additional research areas which need to be incorporated in the research agenda

8. Prioritization of identified research topics within each group

9. The group to consider the following topics in their deliberations

   - Proposals / suggestions (co-ordination mechanism, fundraising & distribution mechanism, resource allocation etc.)

   - Comments (e.g. database, document preparation, research agenda, way forward, & workshop approach etc.)

   - Recommendations

10. A final group presentation and submission of the above comments/ proposals/ recommendations in written form.

[2] Each Group is provided with a copy of the list of the recent environmentally related research compiled by the National Science Council.